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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Klaus ENDRES et al.

Confirmation No. 6063

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Examiner: Empie, Nathan H

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For : METALLIC SUBSTRATES COMPRISING A DEFORMABLE GLASS-TYPE
COATING

AMENDMENT UNDER 37 C.F.R. § 1.116

Commissioner for Patents
U.S. Patent and Trademark Office
Customer Service Window, Mail Stop AE
Randolph Building
401 Dulany Street
Alexandria, VA 22314

Sir:

This is in response to the Final Office Action mailed from the U.S. Patent and Trademark Office on June 14, 2011, which sets a three-month shortened statutory period for reply to expire on September 14, 2011. Applicants hereby request an extension of time for one month and are concurrently filing a formal Request for Extension of Time, together with all requisite fees therefor. If for any reason the Request for Extension of Time is not associated with the file, or the fee submitted herewith is deemed insufficient for any reason, the present submission should be interpreted to include the requisite Request for Extension of Time, and the Patent and Trademark Office is hereby authorized to charge any fees necessary to preserve the pendency of this application, including any extension of time fees which may be required for an Examiner's Amendment, to Deposit Account No. 19-0089.

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Amendments to the Claims are reflected in the listing of claims which begins on page 3 of this paper.

Remarks/Arguments begin on page 11 of this paper.

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. - 77. (cancelled)

78. (new) A process for making a metallic substrate having a vitreous coating, wherein the process comprises

- (a) applying an alkali metal silicate-containing coating sol to the substrate to provide a coating layer on the substrate;
- (b) drying the applied coating layer at room temperature of up to 100°C to obtain a dried coating layer, and
- (c) thermally densifying the dried coating layer of (b) by a two-stage heat treatment comprising,
 - (i) in a first stage, a heat treatment carried out either (A) in an atmosphere comprising from 15 % to 90 % by volume of oxygen at an end temperature of from 350°C to 400°C, or (B) in a vacuum at a residual pressure of ≤ 15 mbar at an end temperature from 120°C to 500°C, and
 - (ii) in a second stage, further densification by a heat treatment in a low-oxygen atmosphere at an end temperature of from 400°C to 600°C up to full densification with formation of a vitreous layer;

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and wherein the process further comprises cooling the heat-treated substrate at a cooling rate of from 1 to 10 K/min.

79. (new) The process of claim 78, wherein the heat treatment of the first stage is carried out according to alternative (A).

80. (new) The process of claim 78, wherein the heat treatment of the first stage is carried out according to alternative (B).

81. (new) The process of claim 80, wherein the heat treatment of the first stage is carried out according to alternative (B) at an end temperature of up to about 200°C.

82. (new) The process of claim 80, wherein the heat treatment of the first stage is carried out according to alternative (B) at a residual pressure of ≤ 5 mbar.

83. (new) The process of claim 78, wherein the heat treatment of the first stage is carried out according to alternative (B) at a residual pressure of ≤ 5 mbar.

84. (new) The process of claim 78, wherein the heat treatment of the second stage is carried out at an end temperature of from 540° to 560°C.

85. (new) The process of claim 78, wherein the heat treatment of the second stage is carried

out in an atmosphere which comprises ≤ 0.5 % by volume of oxygen.

86. (new) The process of claim 84, wherein the heat treatment of the second stage is carried out in an atmosphere which comprises ≤ 0.5 % by volume of oxygen.

87. (new) The process of claim 78, wherein the heat treatment of the second stage is carried out in an inert gas atmosphere.

88. (new) The process of claim 78, wherein the alkali metal silicate-containing coating sol is obtainable by a process comprising a hydrolysis and polycondensation of one or more silanes of formula (I)



wherein the radicals X independently represent hydrolyzable groups or hydroxyl groups, the radicals R independently represent hydrogen, alkyl, alkenyl and alkynyl groups having up to 4 carbon atoms and aryl, aralkyl and alkaryl groups having from 6 to 10 carbon atoms, and n is 0, 1 or 2, with the proviso that at least one silane where n = 1 or 2 is used, or oligomers derived therefrom, in the presence of

- (a) at least one compound selected from oxides and hydroxides of alkali metals and alkaline earth metals, and
- (b) optionally, nanoscale SiO₂ particles.

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89. (new) The process of claim 88, wherein the at least one compound is used in such an amount that an atomic ratio Si : (alkali metal and/or alkaline earth metal) is in a range of from 20:1 to 7:1.

90. (new) The process of claim 89, wherein the atomic ratio is from 15:1 to 10:1.

91. (new) The process of claim 90, wherein an average value of n in the silanes of formula (I) is from 0.2 to 1.5.

92. (new) The process of claim 91, wherein the average value of n is from 0.5 to 1.0.

93. (new) The process of claim 78, wherein a thickness of the vitreous layer is from 2.5 to 4.5 μm .

94. (new) The process of claim 78, wherein the substrate has a structured surface.

95. (new) The process of claim 94, wherein the substrate comprises at least one of steel, stainless steel, zinc-plated steel, chromium-plated steel and enameled steel.

96. (new) A process for making a metallic substrate having a vitreous coating, wherein the process comprises

(a) applying an alkali metal silicate-containing coating sol to the substrate to provide a

coating layer on the substrate;

(b) drying the applied coating layer at room temperature of up to 100°C to obtain a dried coating layer, and

(c) thermally densifying the dried coating layer of (b) by a two-stage heat treatment comprising,

(i) in a first stage, a heat treatment carried out either (A) in an atmosphere comprising from 15 % to 90 % by volume of oxygen at an end temperature of up to 400°C, or (B) in a vacuum at a residual pressure of ≤ 15 mbar at an end temperature of up to 500°C, and

(ii) in a second stage, further densification by a heat treatment in a low-oxygen atmosphere at an end temperature of from 400°C to 600°C up to full densification with formation of a vitreous layer;

and wherein the process further comprises cooling the heat-treated substrate at a cooling rate of from 1 to 10 K/min.

97. (new) The process of claim 96, wherein the heat treatment of the first stage is carried out according to alternative (A).

98. (new) The process of claim 96, wherein the heat treatment of the first stage is carried out according to alternative (B).

99. (new) The process of claim 98, wherein the heat treatment of the first stage is carried out

according to alternative (B) at an end temperature of up to about 200°C.

100. (new) The process of claim 98, wherein the heat treatment of the first stage is carried out according to alternative (B) at a residual pressure of ≤ 5 mbar.

101. (new) The process of claim 96, wherein the heat treatment of the first stage is carried out according to alternative (B) at a residual pressure of ≤ 5 mbar.

102. (new) The process of claim 96, wherein the heat treatment of the second stage is carried out at an end temperature of from 540° to 560°C.

103. (new) The process of claim 96, wherein the heat treatment of the second stage is carried out in an atmosphere which comprises ≤ 0.5 % by volume of oxygen.

104. (new) The process of claim 102, wherein the heat treatment of the second stage is carried out in an atmosphere which comprises ≤ 0.5 % by volume of oxygen.

105. (new) The process of claim 96, wherein the heat treatment of the second stage is carried out in an inert gas atmosphere.

106. (new) The process of claim 96, wherein the alkali metal silicate-containing coating sol is obtainable by a process comprising a hydrolysis and polycondensation of one or more silanes of

formula (I)



wherein the radicals X independently represent hydrolyzable groups or hydroxyl groups, the radicals R independently represent hydrogen, alkyl, alkenyl and alkynyl groups having up to 4 carbon atoms and aryl, aralkyl and alkaryl groups having from 6 to 10 carbon atoms, and n is 0, 1 or 2, with the proviso that at least one silane where n = 1 or 2 is used, or oligomers derived therefrom, in the presence of

- (a) at least one compound selected from oxides and hydroxides of alkali metals and alkaline earth metals, and
- (b) optionally, nanoscale SiO₂ particles.

107. (new) A process for making a metallic substrate having a vitreous coating, wherein the process comprises

- (a) applying an alkali metal silicate-containing coating sol to the substrate to provide a coating layer on the substrate;
- (b) drying the applied coating layer at room temperature of up to 100°C to obtain a dried coating layer, and
- (c) thermally densifying the dried coating layer of (b) by a two-stage heat treatment comprising,
 - (i) in a first stage, a heat treatment carried out either (A) in an atmosphere comprising from 15 % to 90 % by volume of oxygen at an end temperature of up to 400°C, or (B) in a vacuum at a residual pressure of

≤ 5 mbar at an end temperature of up to 200°C, and

- (ii) in a second stage, further densification by a heat treatment in an atmosphere that comprises ≤ 0.5 % by volume of oxygen at an end temperature of from 400°C to 600°C up to full densification with formation of a vitreous layer;

and wherein the process further comprises cooling the heat-treated substrate at a cooling rate of from 1 to 10 K/min.

108. (new) The process of claim 107, wherein the heat treatment of the second stage is carried out at an end temperature of from 540° to 560°C.

109. (new) The process of claim 108, wherein the heat treatment of the first stage is carried out according to alternative (A).

110. (new) The process of claim 108, wherein the heat treatment of the first stage is carried out according to alternative (B).

REMARKS

Entry of the foregoing amendments is respectfully requested.

Summary of Amendments

Upon entry of the foregoing amendments, claims 44-73 and 75-77 are cancelled and claims 78-110 are added, whereby claims 78-110 will be pending, with claims 78, 96 and 107 being independent claims.

Support for the new claims can be found throughout the present specification (see also the cancelled claims).

Applicants emphasize that the cancellation of claims 44-73 and 75-77 is without prejudice or disclaimer, and Applicants expressly reserve the right to prosecute the cancelled claims in one or more continuation and/or divisional applications.

It further is pointed out that entry of the present amendments is proper because these amendments do not raise any new issues (but rather reduce the number of issues) and do not require a further search. In this regard, Applicants note that all of the elements recited in the claims submitted herewith are (also) recited in claims which have previously been considered by the Examiner.

Summary of Office Action

Claims 44-73 and 75-77 are (remain) rejected under 35 U.S.C. § 112, first paragraph, as allegedly failing to comply with the written description requirement.

Claims 44, 45, 49-51, 53-59, 63-66, 68-73 and 75-77 are (remain) rejected under 35

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U.S.C. § 103(a) as allegedly being unpatentable over Mennig et al., U.S. Patent No. 6,162,498 (hereafter “MENNIG”) in view of Horne et al., US 2003/0118841 (hereafter “HORNE”).

Claims 46 and 60 remain rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over MENNIG in view of HORNE and further in view of Wizon, U.S. Patent No. 3,565,749 (hereafter “WIZON”).

Claims 52 and 67 remain rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over MENNIG in view of HORNE and further in view of Chou et al., “Sol-Gel-Derived Hybrid Coatings for Corrosion Protection” in J. Sol-Gel Sci. and Tech. 26, pp. 321-327, 2003 (hereafter “CHOU”).

Claims 44, 47-51, 53-58, 61-66, 68-73 and 75-77 are (remain) rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over MENNIG in view of Loxley et al., U.S. Patent No. (hereafter “LOXLEY”).

Claims 52 and 67 remain rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over MENNIG in view of LOXLEY and further in view of CHOU.

Response to Office Action

Reconsideration and withdrawal of the rejections of record are respectfully requested, in view of the foregoing amendments and the following remarks.

Response to Rejections under 35 U.S.C. § 112, First Paragraph

Claims 44, 45, 49-51, 53-59, 63-66, 68-73 and 75-77 are (remain) rejected under 35 U.S.C. § 112, first paragraph, as allegedly failing to comply with the written description

requirement. In particular, the Examiner continues to take the position that there is inadequate support for the recited first heat treatment “to an end temperature of at least 350°C” (for A) and “to an end temperature of at least 120°C” (for B) in claims 44 and 56, especially in view of the exemplified embodiments which allegedly appear to employ temperatures below the recited temperatures.

Applicants respectfully (and strongly) disagree with the Examiner in this regard for all of the reasons which are set forth in the responses to previous Office Actions. The corresponding remarks are expressly incorporated herein. At any rate, the rejected claims are cancelled, wherefore this rejection is moot.

Regarding the claims submitted herewith it further is noted with respect the recitation of “in a first stage, a heat treatment carried out either (A) ... at an end temperature of from 350°C to 400°C” in claim 78 that the Examiner acknowledges that there is support in the instant specification for temperature ranges (for A) of “up to about 400°C” (which is interpreted by the Examiner as inclusive of all temperatures of 400°C and below) and “at 350°C”. Further, since an end temperature of 350°C is disclosed in an exemplified embodiment of the claimed process, it is apparent that 350°C is a preferred end temperature. Accordingly, the present specification discloses both end temperatures of 400°C and below and a favorable end temperature of 350°C. Thus, there can be no doubt that the range of from 350°C to 400°C is disclosed in the instant specification and no temperature ranges are selectively excluded.

Regarding the recitation of a “heat treatment carried out ... (B) ... at an end temperature from 120°C to 500°C” in claim 78 the above comments apply *mutatis mutandis*. Specifically, the Examiner acknowledges that there is support in the instant specification for temperature ranges

(for B) of “up to about 500°C, and up to about 200°C” and “up to (and now including) about 120°C” (which is interpreted by the Examiner as inclusive of all of these temperatures and below). Further, since an end temperature of 120°C is disclosed in an exemplified embodiment of the claimed process it is apparent that 120°C is a preferred end temperature. Accordingly, the present specification discloses both end temperatures of 500°C and below and a favorable end temperature of 120°C. Thus, there can be no doubt that the range of from 120°C to 500°C is disclosed in the instant specification and no temperature ranges are selectively excluded.

It further is pointed out that one of ordinary skill in the art will understand that the embodiments of the claimed process described in the instant specification indicate specific values for the end temperature. Further, the recitations at issue relate to “end temperatures”. These end temperatures are achieved by heating, i.e., by (gradually) increasing the temperature (see the mentioning of a “heating rate” in the Examples). In other words, the substrate is heat treated by gradually increasing the temperature “up to” a certain end temperature. The substrate is maintained at this “end temperature” or “maximum temperature” for a certain period of time (see page 3, third paragraph). A heat treatment with a certain heating rate up to a certain end temperature is conventional in this technical field. In the Examples of the instant specification specific values for the end temperature, i.e., not merely certain upper or lower limits, are indicated.

Regarding instant independent claims 96 and 107, it is noted that the temperature ranges for (A) and (B) recited therein are essentially those which are expressly recited in the instant specification.

Applicants submit that for at least all of the foregoing reasons and the additional reasons set forth in the responses to the previous Office Actions, the rejection under 35 U.S.C. § 112, first paragraph is unwarranted.

Response to Rejections under 35 U.S.C. § 103(a) over MENNIG in View of HORNE

Claims 44, 45, 49-51, 53-59, 63-66, 68-73 and 75-77 are (remain) rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over MENNIG in view of HORNE. The Examiner again essentially takes the position that MENNIG teaches a process of the type recited in the rejected claims but concedes that MENNIG fails to disclose the two-stage thermal densification recited in the instant independent claims. In this regard, the rejection again alleges that HORNE cures the noted deficiency of MENNIG with respect to alternative (A) of the first stage of the two-stage thermal densification recited in claims 44 and 56.

Applicants respectfully disagree with the Examiner in this regard for all of the reasons which are set forth in the response to previous Office Action. The corresponding remarks are expressly incorporated herein. At any rate, the rejected claims are cancelled, wherefore this rejection is moot.

It further is noted that the Examiner appears to acknowledge that MENNING fails to disclose the first stage heat treatment alternative (A) recited in the instant independent claims but continues to allege that this heat treatment would have been rendered obvious to one of ordinary skill in the art by HORNE (see, e.g., paragraph bridging pages 19 and 20 of the instant Office Action). In this regard, Applicants point out again that MENNIG and HORNE relate to different technical fields (i.e., a process for providing a metallic surface with a vitreous layer which is

both decorative and scratch resistant and corrosion inhibiting in the case of MENNIG and optical materials and optical devices provided with coatings formed from metalloid oxides and metal-metalloid compositions comprising improved nanoscale particles in the case of HORNE).

The Examiner further alleges that HORNE teaches conducting an intermediate densification in oxygen to remove carbon contaminants and “[a]s Menning [*sic*] is interested in forming dense silica coatings from precursors containing carbon, one of ordinary skill in the art would be motivated by the teaching of Horne as it would provide a means to remove such carbonaceous materials and aid in the densification of the final silica glass coating”. Page 19, first paragraph of the instant Office Action.

Applicants respectfully disagree with the Examiner in this regard. In particular, according to col. 1, lines 36-46 of MENNIG, “[a]ccording to the present invention it has now been found that by using specific, organically modified systems based on SiO₂ vitreous layers can be formed on metallic surfaces ... without occurrence of cracking upon drying and densification thereof. Said effect is attributed to the improved relaxation behavior of the organically modified silica gel and silica, respectively, skeletons. Surprisingly it has also been found that such layers can be converted into dense SiO₂ films ... already at relatively low temperatures (generally starting from 400°C).”

Accordingly, MENNIG teaches that the organically modified silica sols can be converted into dense silica films. There is nothing in MENNIG which would indicate or suggest any problems related to the removal of the organics. According to MENNIG there is no residual organic (carbonaceous) material in the densified silica layer. The Examiner has failed to explain why a person of ordinary skill in the art considering the teaching of MENNIG would allegedly

have an apparent reason to apply additional means for solving a problem (removal of carbonaceous materials) which according to MENNIG does not exist.

Further, according to MENNIG a dense silica film is obtained from an organically modified silica gel by a heat treatment starting from 400°C, e.g., in air (see, e.g. Example 4 of MENNIG). HORNE describes the same step (heating at 450°C in oxygen) to remove carbon contaminants as an intermediate step. There is no apparent reason and in fact, no reason at all for one of ordinary skill in the art to carry out the step according to HORNE as a further intermediate step in the process of MENNIG.

Even further, the only heat treatment step of the process of MENNIG is applied to an organically modified silica sol, i.e., a silica structure in which organic groups are chemically bonded (to Si) in the structure. By contrast, the corresponding heat treatment of HORNE is carried out in order to remove “carbon contaminants” in the coating (see paragraph [0300] of HORNE). As already set forth, according to HORNE the coating is deposited by flame pyrolysis of precursors (flame temperature at least 750°C, see paragraph [0298] of HORNE). It is apparent that at such high temperatures organic groups present in the precursors are destroyed (pyrolyzed) to form gaseous CO₂, with small amounts (less than 1 wt.%, i.e., traces, see paragraph [0290] of HORNE) of “carbonaceous material” (e.g., carbon black, charcoal) remaining in the coating as impurities. These “carbon contaminants” of the coating of HORNE are not chemically bonded to the structure and can thus, not be compared with the organic groups that are chemically bonded in the organically modified silica sol to which the heat treatment according to MENNIG is applied.

In other words, MENNIG relates to an organically modified silica sol, i.e., (uncompromised) organic groups chemically bonded within a silica structure, whereas HORNE relates to an inorganic silica coating comprising small amounts of carbonaceous materials (pyrolyzed organic material) as impurity. Further, there is no basis for assuming that the “carbon contaminants” to which HORNE refers (also) exist in the dried coatings described by MENNIG to which the heat treatment described therein is applied.

Applicants submit that for at least all of the foregoing reasons and the additional reasons set forth in the response to the previous Office Action, the instant rejection under 35 U.S.C. § 103(a) over MENNIG in view of HORNE is without merit.

Response to Remaining Rejections under 35 U.S.C. § 103(a) over MENNIG/HORNE

Claims 46 and 60 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over MENNIG in view of HORNE and further in view of WIZON and claims 52 and 67 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over MENNIG in view of HORNE and further in view of CHOU.

Applicants respectfully disagree with the Examiner in this regard as well. At any rate, the rejected claims are cancelled, wherefore this rejection is moot.

If further is pointed out that all of the rejected claims are dependent claims and are not rendered obvious for at least all of the reasons which are set forth above with respect to the independent claims from which they depend. WIZON and CHOU clearly fail to cure the noted deficiencies of MENNIG and HORNE.

Response to Rejections under 35 U.S.C. § 103(a) over MENNIG in View of LOXLEY

Claims 44, 47-51, 53-58, 61-66, 68-73 and 75-77 are (remain) rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over MENNIG in view of LOXLEY. The Examiner again essentially takes the position that MENNIG teaches a process of the type recited in the rejected claims but concedes that MENNIG fails to disclose the two-stage thermal densification recited in the instant independent claims. In this regard, the rejection alleges that LOXLEY and in particular, the passage from col. 9, line 30 to col. 10, line 57 thereof, cures the noted deficiency of MENNIG with respect to alternative (B) of the first stage of the two-stage thermal densification recited in claims 44 and 56.

Applicants respectfully disagree with the Examiner in this regard for all of the reasons which are set forth in the response to previous Office Action. The corresponding remarks are expressly incorporated herein. At any rate, the rejected claims are cancelled, wherefore this rejection is moot.

It further is noted that the Examiner appears to acknowledge that MENNIG fails to disclose the first stage heat treatment alternative (B) recited in the instant independent claims but continues to allege that this heat treatment would have been rendered obvious to one of ordinary skill in the art by LOXLEY (see, e.g., paragraph bridging page 21, last paragraph of the instant Office Action). In this regard, Applicants point out again that MENNIG and LOXLEY relate to different technical fields (i.e., a process for providing a metallic surface with a vitreous layer which is both decorative and scratch resistant and corrosion inhibiting in the case of MENNIG and sintered high-purity quartz glass products and methods for making same in which a shaped

silica body or preform is made from an aqueous slurry of micronized silica particles by gel casting, slip casting or electrophoretic deposition in the case of LOXLEY).

Further, the passage of LOXLEY relied upon by the Examiner in this regard, col. 9, line 30 to col. 10, line 57, relates to the sintering of a “porous silica preform”. The porous silica preform is prepared, e.g., from a slurry of fused quartz glass particles (see, e.g., col. 10, lines 39-42 and col. 28, Example V of LOXLEY). A corresponding silica preform has larger pores “which cause significant gas bubbles in the sintered glass” (col. 9, lines 55-58). LOXLEY teaches impregnating the pores with a silica sol (col. 9, lines 39-41) and to carry out a first heat treatment *in vacuo* “to cause a substantial increase in the density and/or to seal the pores thereof during the first stage” (col. 10, lines 27-31).

Accordingly, LOXLEY teaches that in the case of using a porous silica preform prepared from fused quartz particles the pores can be sealed, i.e., the density can be increased, by impregnation of the pores with a silica sol and a first heat treatment *in vacuo*.

By contrast, according to MENNIG a coating sol is applied to the substrate, resulting in gel formation (sol gel process). The coating to be treated according to MENNIG is not a porous silica preform as described by LOXLEY. Further, the measures adopted by LOXLEY (impregnation and heat treatment *in vacuo*) are used to seal or densify the pores of the porous silica preform. In view thereof, it is not seen that one of ordinary skill in the art has an apparent reason to apply the measures described by LOXLEY in the process of MENNIG, i.e., a process wherein no corresponding porous silica systems are encountered.

Applicants submit that for at least all of the foregoing reasons and the additional reasons set forth in the response to the previous Office Action, the instant rejection under 35 U.S.C. § 103(a) over MENNIG in view of LOXLEY is unwarranted.

Response to Remaining Rejection under 35 U.S.C. § 103(a) over MENNIG/ LOXLEY

Claims 52 and 67 remain rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over MENNIG in view of LOXLEY and further in view of CHOU.

Applicants respectfully disagree with the Examiner in this regard as well. At any rate, the rejected claims are cancelled, wherefore this rejection is moot.

It further is noted that the rejected claims are dependent claims and are not rendered obvious for at least all of the reasons which are set forth above with respect to the independent claims from which they depend. CHOU clearly fails to cure the noted deficiencies of MENNIG and LOXLEY.

CONCLUSION

In view of the foregoing, it is believed that all of the claims in this application are in condition for allowance, wherefore an early issuance of the Notices of Allowance and Allowability is again respectfully solicited. If any issues yet remain which can be resolved by a telephone conference, the Examiner is respectfully invited to contact the undersigned at the telephone number below.

Respectfully submitted,
Klaus ENDRES et al.

/Heribert F. Muensterer/

Heribert F. Muensterer
Reg. No. 50,417

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GREENBLUM & BERNSTEIN, P.L.C.
1950 Roland Clarke Place
Reston, VA 20191
(703) 716-1191